AMIGA
Analysis of the interstellar Medium of Isolated GAlaxies

Molecular gas in Hickson Compact Groups

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Hickson Compact Groups of galaxies (HCG's), due to their high galaxy densities and low density environments are unique laboratories for studying galaxy interaction and evolution and determining whether the physical trends of galaxies must be explained in terms of their nature or nurture. Previous observations found both their star formation rate (SFR, traced by their FIR luminosity) and H_2 mass content to be lower than predicted, suggesting that the the low star formation might be due to a low gas content. We performed new CO(1-0) and CO(2-1) observations with the IRAM 30-m radiotelescope in order to test this hypothesis with a statistically significant sample. Our results agree with the previous model, showing a good correlation between the deficiency of star formation and of the gas (both atomic and molecular) content.

INTRODUCTION

HCG's, defined by Hickson [1] in 1982, are highly compact groups of 4 up to 8 galaxies in an isolated environment. Galaxies in HCG's are generally deficient in HI and do not show a strong enhancement in their star formation rate (traced by their FIR luminosity), contrary to violently interacting pairs [2] [3].

An evolutionary sequence has been suggested [4] driven by a continuous atomic gas loss, first from individual galaxies and afterwards from the whole group. In HI deficient groups a lower than expected H_2 mass and FIR luminosity have been found [4], indicating that low star formation might be due to a lack of gas. Since the sample was not statistically significant, we have performed new CO (tracer of H_2 mass content) observations to enlarge the H_2 mass data sample. This way, we want to determine whether there is a correlation between H_2 mass and HI mass deficiencies. If so, low star formation rates in HCG's galaxies could be explained as a consequence of the lack of cold gas available to fuel star formation.

THE SAMPLE

We observed the CO (1-0) and (2-1) emission of 51 galaxies with the IRAM 30m radiotelescope. Together with previous observations [5] [6], we achieved a 94 galaxies sample belonging to 22 different HCG's. The groups in our sample contain at least one spiral galaxy, are placed at a distance < 100 Mpc, and show different degrees of HI deficiency.

To complete the multiwavelength study, we have compiled also FIR data from IRAS (processed with SCANPI tool), HI data from VLA observations and blue luminosity data from the LEDA database.

The H_2 masses calculated from CO emission have been aperture-corrected assuming an exponential distribution of CO emission [7]. The deficiency in luminosity or gas content is defined as the difference between the logarithm of the predicted magnitude and the logarithm of the observed one. Both predicted H_2 mass [7] [8] and predicted FIR luminosity [9] have been calculated from the blue luminosity of the galaxy following the fit found in the analysis of a sample of isolated galaxies from the AMIGA [10] catalogue. The predicted HI mass was also calculated from the blue luminosity and morphological type [11].

RESULTS

In Figure 1 we can see the correlation between H_2 mass and L_b, with the fit found in the case of the isolated galaxies of the AMIGA catalogue.

Figure 2 shows that there is a correlation between the deficiency in FIR luminosity (tracing SF) and that in H_2 mass. The deficiency in H_2 mass is higher than in FIR luminosity . Also the deficiency in HI mass shows a correlation with that of FIR luminosity, although weaker (Figure 3). The deficiency in HI mass is considerably higher than those in FIR luminosity or H_2 mass, suggesting the HI is more easily removed from galaxies.

The results confirm the previous results [4] (based on less significant statistics) which showed a correlation between gas deficiency and star formation deficiency.

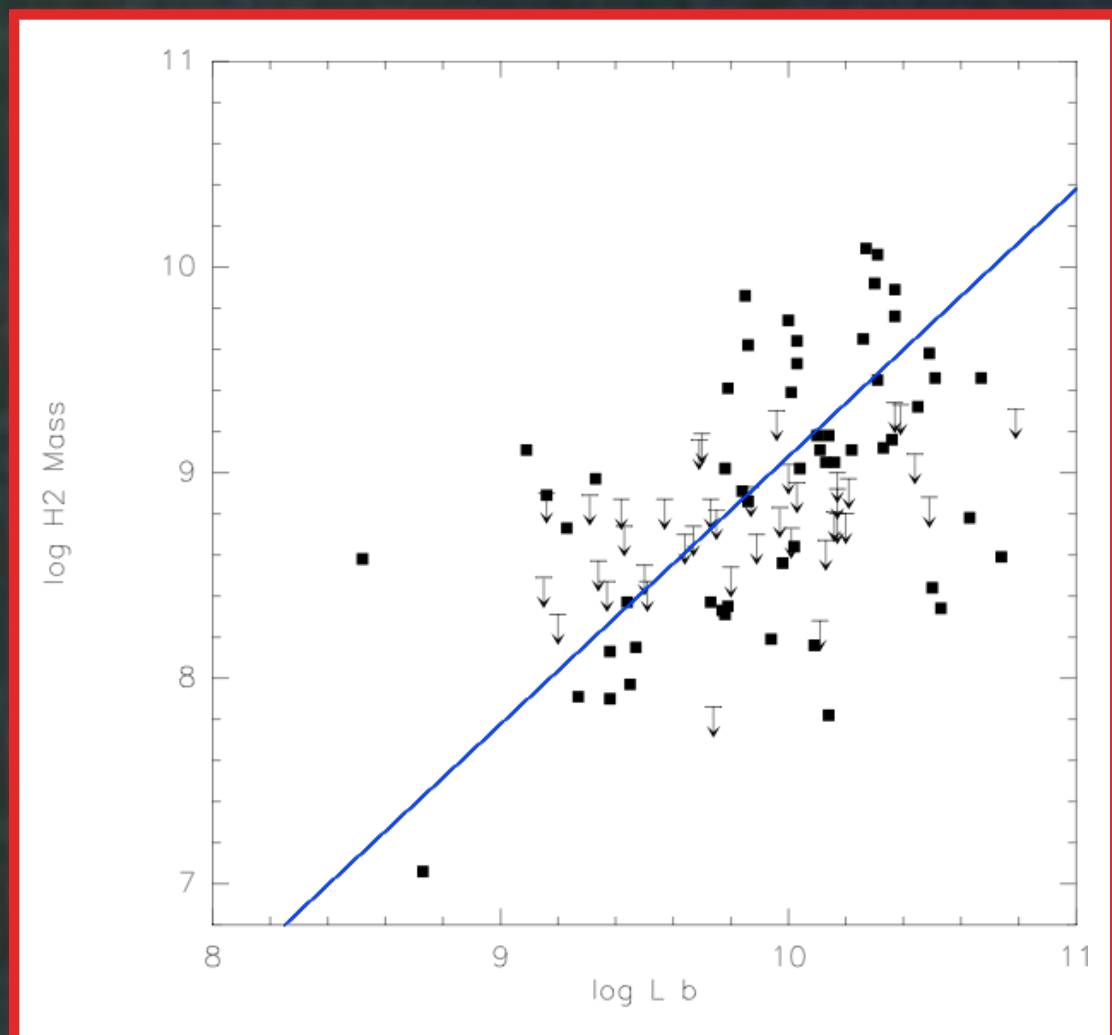

Figure 1. log(H_2 mass) vs log(Lb) for each galaxy in our HCG's sample. The line corresponds to the Lb vs H_2 fit found for the AMIGA catalogue galaxies [9]

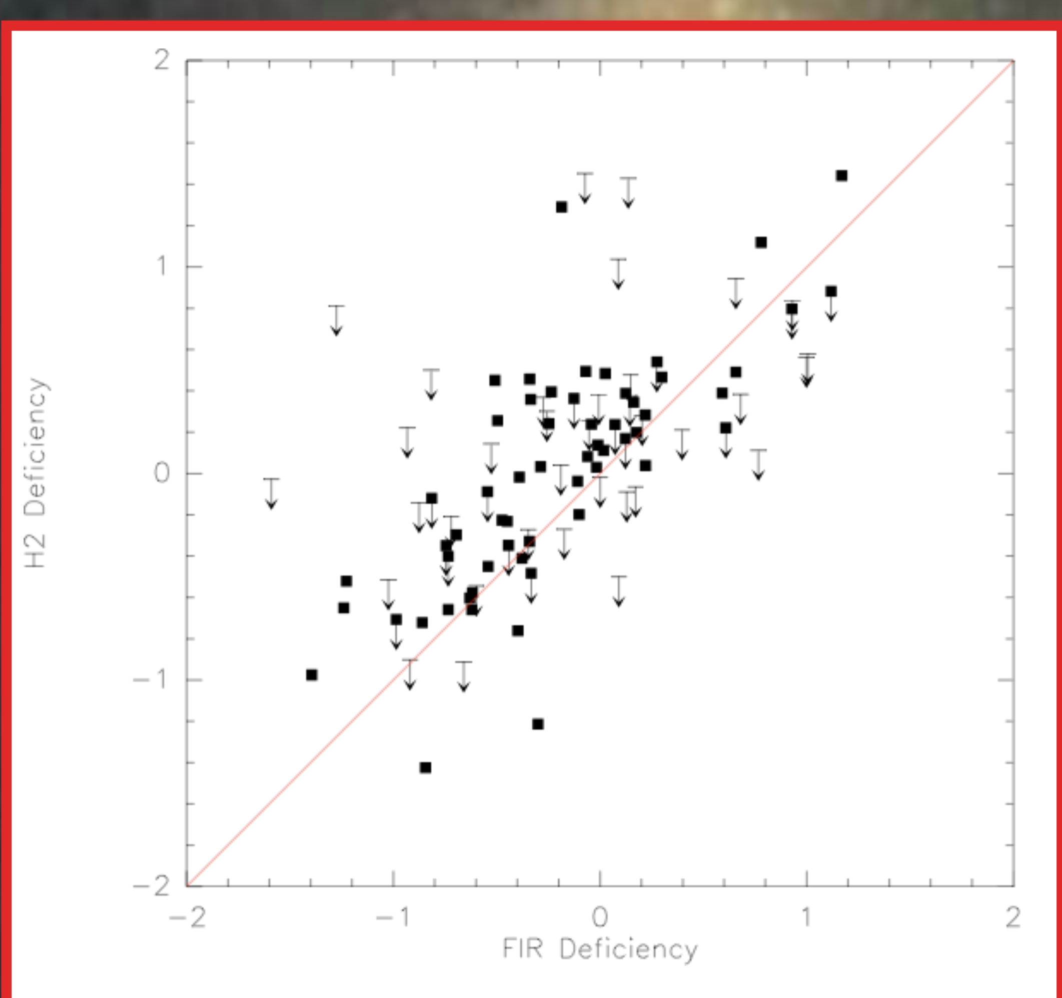

Figure 2. H_2 mass deficiency vs FIR emission luminosity for each galaxy. The line plotted represents equal deficiencies.

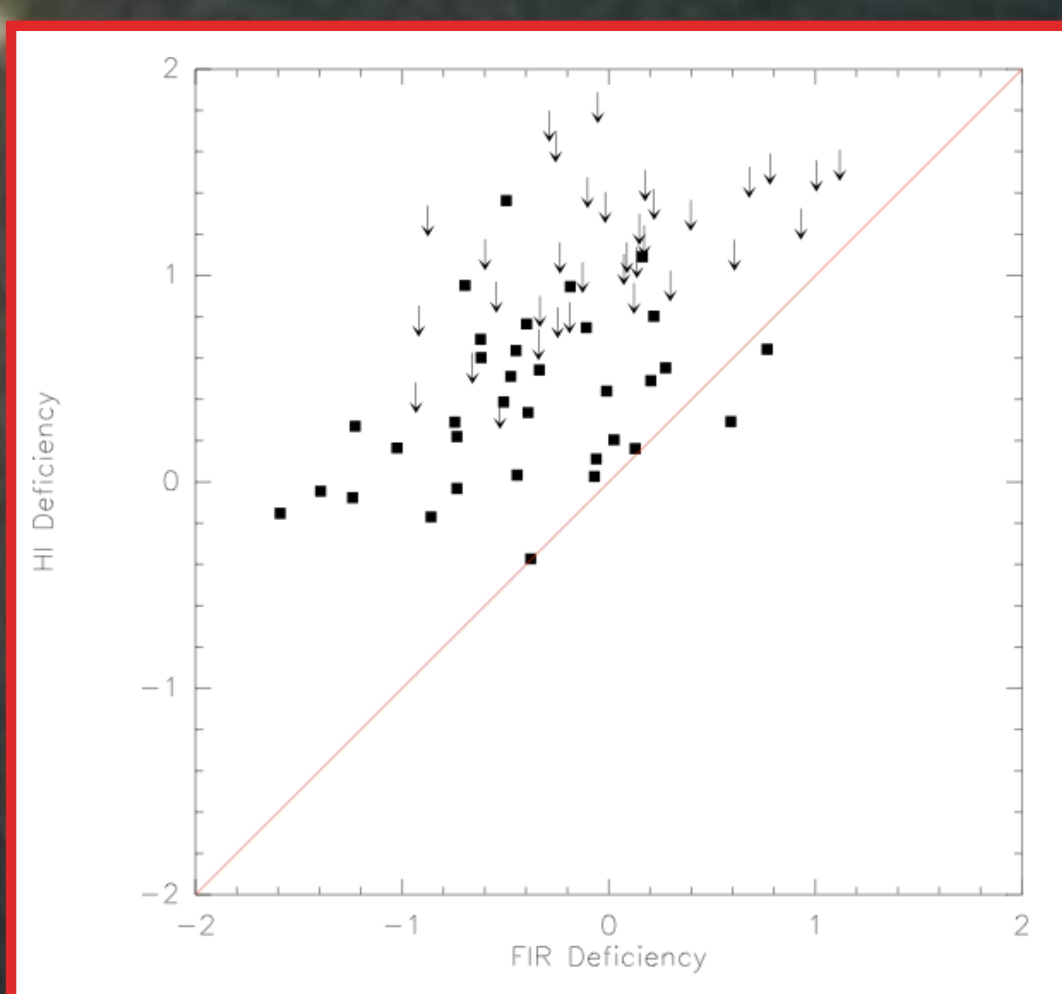

Figure 3. HI mass deficiency vs FIR luminosity deficiency for each galaxy. The line plotted represents equal deficiencies.

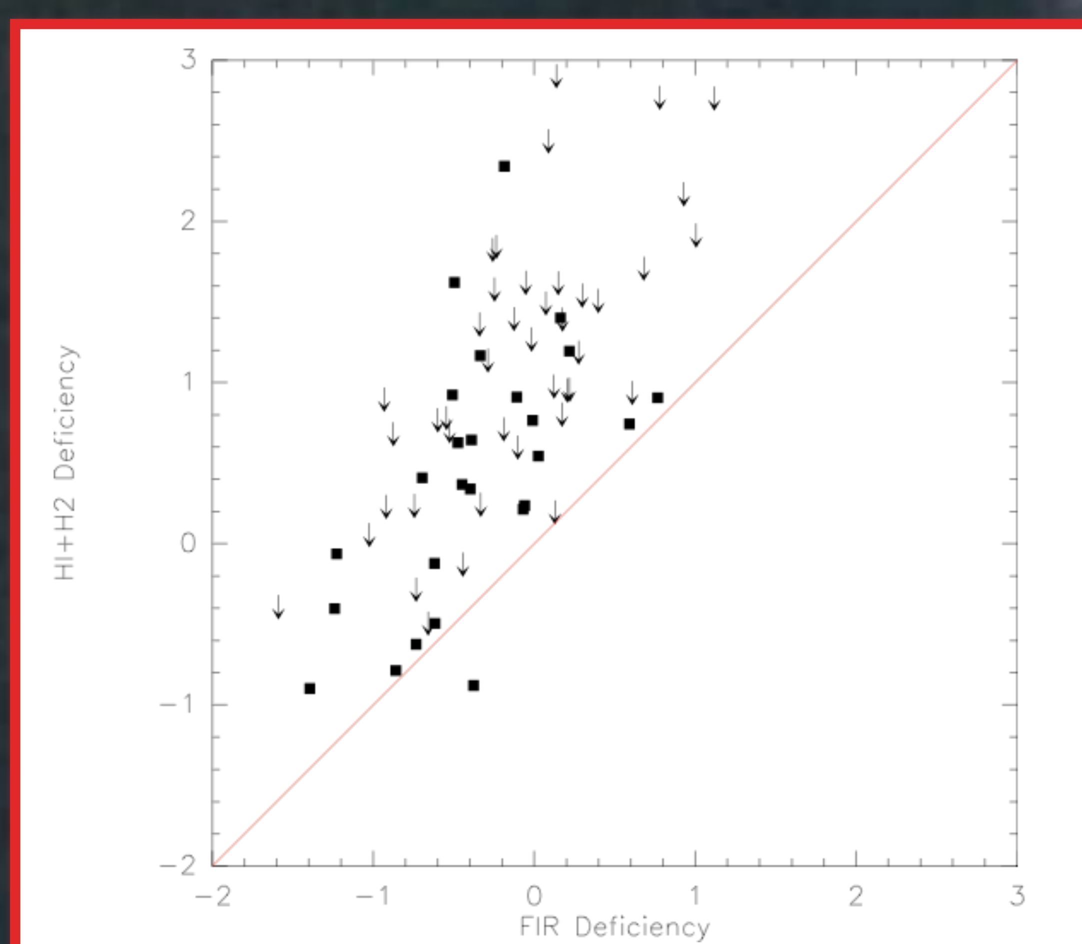

Figure 4. HI+H_2 mass deficiency vs FIR luminosity deficiency for each galaxy. (HI+H2) deficiency is defined as log(predicted HI+H_2) - log(observed HI+H_2). The line plotted represents equal deficiencies.

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